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PART IV COLLECTION OF RELIABILITY, AVAILABILITY AND MAINTAINABILITY DATA FROM FIELD PERFORMANCE

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PART IV COLLECTION OF RELIABILITY, AVAILABILITY AND MAINTAINABILITY DATA FROM FIELD PERFORMANCE

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Indian Standard

GUIDE ON RELIABILITY OF ELECTRONIC AND ELECTRICAL ITEMS

PART IV COLLECTION OF RELIABILITY, AVAILABILITY AND MAINTAINABILITY DATA FROM FIELD PERFORMANCE

0. FOREWORD

0.1 This Indian Standard (Part IV) was adopted by the Indian Standards Institution on 19 June 1974, after the draft finalized by the Reliability of Electronic and Electrical Components and Equipment Sectional Committee had been approved by the Electrotechnical Division Council.

0.2 This standard provides guidance for the collection of reliability data relating to the field performance of electronic and electrical items. It provides for the acquisition of data sufficiently comprehensive to permit detailed failure and failure-rate analysis of items operating under various conditions, namely, time, environment, storage, stand-by, repair, etc.

0.2.1 It is also emphasized in this standard that meaningful reliability data shall include the data on successes (performance without failure), as well as data on failures. In other words, this standard is not intended to be only a failure-reporting document.

0.2.2 This standard also provides guidance for the collection of data from which the maintenance and availability aspects of items may be considered.

0.2.3 In all cases, it is important to distinguish between the items which fail and items which are wrongly removed.

0.3 This standard is largely based on IEC Pub 362-1971 'Guide for the collection of reliability, availability and maintainability data from field performance of electronic items', issued by the International Electrotechnical Commission.

0.4 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test, shall be rounded off in accordance with IS : 2-1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

---

*Rules for rounding off numerical values (*revised*).

1. SCOPE

1.1 This standard (Part IV) provides guidance for the collection of reliability data relating to the field performance of electronic and electrical items. It also provides guidance for the collection of data from which maintenance and availability aspects of items may be considered.

2. TERMINOLOGY

2.1 For the purpose of this standard, the terms and definitions covered in IS : 1885 (Part XXXIX)-1974* shall apply.

3. OBJECTIVES

3.1 The specific objectives of the collection of reliability data on the field performance of electronic and electrical items are:

a) To provide for a survey of the actual reliability level and, hence, to enable the predicted reliability characteristic of the item to be compared with field data, and thereby improve future predictions;

b) To provide data for improving the reliability, both of the current item and of future developments; and

c) To provide data for the organization and management of the maintenance operation (preventive maintenance, corrective maintenance, service personnel, spare parts stores, etc).

4. DATA REQUIRED

4.1 Consideration of the objectives specified in **3**, defines the need for a system which provides for the collection of documented data covering:

a) the total population under observation,

b) operational conditions,

c) failures of the items, and

d) maintenance operations.

5. GUIDELINES

5.1 It is the intention of this standard to provide guidelines for setting up data collection schemes which are consistent with **3** and **4**, and which may be applied either during investigations of samples of item, or on a more widespread basis by large maintenance and/or service organizations.

5.2 It is considered that, if such guidelines are followed, accuracy and completeness of reporting, which are paramount if such schemes are to be of value, will be promoted by the collection of standardized information. Moreover, such standardization will facilitate the interchange of information between users on one hand and manufacturers and designers on the other hand.

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*Electrotechnical vocabulary: Part XXXIX Reliability of electronic and electrical items.

NOTE — To obtain optimum results from the collection of data, it is desired that the entire programme of reporting, analysis and dissemination of reasults be closely co-ordinated.

6. REPORTS

6.0 General — The suggested contents of reports covering over-all use, field failures and preventive maintenance are shown in Appendix A, for reporting on both the performance of individual items and on the whole population under consideration. It should be noted that, in the case of reports on individual items, the relative content of use and failure reports will vary markedly with the items considered and the type of operation. For instance, in the case of large installations maintained *in situ*, the use and failure reports will probably be combined, whereas in the case of smaller equipment maintained at a central workshop, simple failure reports will probably be prepared by the service engineer and use reports by the office controlling the operation of the equipment.

NOTE 1 — The information called for in Appendix A is intended to provide data, whereby the reliability of items functioning under specific conditions in the field may be assessed and compared with the predicted reliability of those items when functioning under the same or closely similar conditions. Alternatively, if the items in the total population under observation are operating under somewhat different conditions, the results of operation under these different conditions may furnish information of significance from the point of view of the applicability of the item, or measures needed for its reliability improvement.

NOTE 2 — Sufficiently detailed reports permit the estimation of reliability, not only of the elements, but also of the items to which the elements pertain. Of course, the populations considered in the reports should be homogeneous from the point of view of the constitution and working conditions of the items forming these populations.

NOTE 3 — Failure rates are determined for a given period of reference. Hence, the failures reported by means of the form suggested in Appendix A should correspond, time-wise, to the ' use ' experience of the total population of similar items. It is important not only that the same populations be involved in both failure and use reports, but also that the time periods of reference in each be suitably co-ordinated. Correct data in respect to the time history of the items is of fundamental value.

6.1 Use Reporting — Data reporting should be supported by information on the use of the items. Where schemes are in operation for the reporting of all failures, it is necessary to collect data on the use of the whole population of items (the total number of similar items under observation).

6.2 Failure Reporting

6.2.1 Failure reports should cover all failures which have been observed. They should also contain sufficient information to identify misuse failures. Failures considered to be attributable to any maintenance action should be so noted.

6.2.2 Appendix A is considered to be sufficiently comprehensive to cover the requirements of detailed investigation of an individual failure. Where economic reasons or lack of resources make it undesirable to collect all of the failure data indicated, it may be desirable to agree upon a shortened form of report which may be used to collect limited data on all relevant failures, with an option to call for the full report in specific cases.

6.2.3 Appendix A does not provide the physical format for a failure form. As far as the equipment/system is concerned, an important part of the data such as the general operating conditions, may be found in other documents, particularly the use report.

6.3 Preventive Maintenance Reporting — Essentially, preventive maintenance is scheduled so as to forestall failure or eliminate failure entirely. Therefore, reporting action taken in this sense is not a failure report nor is it a use report. However, since the data are essentially the same as those required for **6.1** and **6.2**, the information may be included in the same scheme. When no replacements or repairs are made, the action may be classified as a 'Use' report. When the preventive maintenance action results in a replacement or repair, the report may be treated as a 'Failure' report even though the item has in fact not failed in operation.

6.3.1 These differences are detectable when the Field Performance Report is accurately completed.

APPENDIX A

(*Clauses* 6.0, 6.2.2 *and* 6.2.3)

FIELD PERFORMANCE REPORT

A-0. Code reference 'I' and 'P' below in parentheses refer respectively to 'Individual' and 'Population' reporting. Numerals in parentheses refer to clauses in the standard or to notes in this Appendix.

A-1. NUMBER AND DATE OF REPORT (I.P.)

A-2. NAME AND ADDRESS OF USER, LOCATION OF ITEM (I.)

A-3. NATURE OF REPORT

a) 'Use' report (*see* **6.1**).

b) 'Failure' report (*see* **6.2**).

c) 'Preventive maintenance' report (*see* **6.3**).

A-4. ITEM IDENTIFICATION (I.P., Note 1)

A-5. NUMBER OF ITEMS CONSIDERED (P., Note 2)

A-6. TIME HISTORY OF ITEM (Note 3)

a) Date of manufacture or of reconditioning (I.).

b) Built or modified state — nature and date of modifications likely to change reliability of item (I.P.).

NOTE — Underline modification likely to concern failures noted in this report.

c) Date first placed in use (I., Note 4).

d) Cumulative operating time (or cycles) elapsed since this date (I.P.) [*see* **A-6** (c)].

e) Date placed in use since last modification noted in **A-6**(b) (I., Note 4).

f) Date last placed in use (I., Note 4).

g) Cumulative operating time (or cycles) elapsed since this date (I.P.) [*see* **A-6**(b)].

h) Storage or transportation conditions including remarks on packing and cumulative time prior to last place in use (I.P., Note 4).

j) Nature and date of last maintenance task — operating time (or cycles) elapsed since this date (I.).

k) Cumulative time non-operational but believed serviceable (I.P.).

m) Cumulative time non-operational but believed unserviceable (I.P.).

n) Cumulative time on stand-by (I.P.).

A-7. GENERAL OPERATING CONDITIONS (I.P.)

A-7.1 Type of Installation

A-7.1.1 *Mobility Level*

a) Stationary.

b) Transportable.

c) Portable (item specially built for easy transportation by one man only).

A-7.1.2 *Nature of Support*

a) On ground.

b) Carried by man (for example, man pack).

c) In land vehicle.

d) In ship.

e) In aircraft.

f) Other (specify).

A-7.2 Specific Environment

a) Indoors, open air under shelter, open air, etc.

b) Temperature range (mean and extreme values).

c) Humidity (absolute and/or relative) range (mean and extreme values).

d) Environmental pressure range (mean and extreme values).

e) Nature of atmosphere (air conditioned, temperature regulated, cleanliness monitored, dusty, sandy, salty, corrosive, etc).

f) Vibrations, shocks, bumps (frequency, amplitude, acceleration, waveform, etc).

g) Others (specify).

A-7.3 Mode of Operation

a) Continuous.

b) Intermittent (give cycle).

c) Stand-by.

d) Single operation (for example, one shot devices).

e) Storage.

A-8. ITEM FAILURE DESCRIPTION

A-8.1 Symptoms and Premonitory Signs (I.)

A-8.2 Failure Detected During Operation, Periodic Checks and Preventive Maintenance Schedules (I.)

A-8.3 Item Failure Mode (Identification of Functions Affected) (I.P.)

A-8.4 Failure Causes (I.P., Note 5)

a) Inherent to item under observation.

b) Misuse failure.

c) Induced by maintenance action.
d) External to item under observation (Note 6).
e) Secondary (caused by related item).
f) Under investigation.
g) Unknown.
h) Unconfirmed.

A-9. ITEM FAILURE ANALYSIS (Note 7)

A-9.1 List (Identification) and Circuit Reference of Failed Parts (I.)

A-9.2 Part Failure Mode (I., Note 8)

A-9.3 List (Identification) and Circuit Reference of Parts Primarily Responsible for Item Failure (I.P.)

A-9.4 If Necessary, Parts baing Retained Pending Investigation and Their Location (I.)

A-10. ACTION TAKEN (I.P.)

A-10.1 Diagnose to: Item, Part

Correct by : Replacement, repair, adjustment, modification, lubrication.

Verify by : Check, test.

A-10.2 Active Technician Time (Diagnostic+Repair+Tests+ ...)

A-10.3 Down-time (Including, for Example, Waiting for Components, Transport, etc)

A-10.4 Maintenance Level

A-11. ASSESSMENT BY FIELD OR MAINTENANCE ENGINEER (I.P.)

A-11.1 Additional Pertinent Data (Note 9)

A-11.2 Observations and Opinions as to Cause of Failure (Note 10)

A-12. POSITION, NAME AND SIGNATURE OF THE ORIGINATOR OF THE REPORT (I.P.)

A-13. POSITION, NAME AND SIGNATURE OF THE PERSON RESPONSIBLE FOR EDITING THE REPORT (I.P., Note 11)

NOTE 1 — The more complete the indentification of the item involved, the less guessing the analyst does, and corrective action may result more rapidly.

As applicable for an item and its application, give type, series or mark, serial number, date of manufacture, and name of the manufacturer of the item(s), specification (if applicable) and drawing circuit diagram, schematic, item number(s) and revision number(s).

Note 2 — When this report is used to report successful operational periods or missions and preventive maintenance action, it is possible to cover more than one item of basically identical design. The serial number and date of manufacture may have to be listed separately, but otherwise all data are equally applicable to all items covered.

Note 3 — The history data are expected to be available on major items or major sub-assemblies of the item. Any item having an elapsed time indicator or cycle counter may be construed to be a major item. Each major item should have a history record from which these data may be obtained. Such data sources include plant or facility operating records and maintenance rework. If these data are available for smaller items, component parts, etc, it will aid in analysis and corrective action tasks.

If the item is intended for two or more differently defined output functions, the information of paragraphs (d), (g) and (n) should be given for all functions relevant to the failure.

Note 4 — Successive operations corresponding to the operation cycle of **A-7.3**(b) are not reported as 'placed in use'.

Note 5 — In cases where the failure immediately follows a period of transport, storage or stand-by, the relevant conditions shall be stated.

Note 6 — Excessive mains voltage or fluctuations, overloads, interruption, etc. Details of conditions immediately before the failure are useful.

Note 7 — Where several detail components (or parts) have failed at the same time, each such component (or part) shall be indentified.

Note 8 — Open or short-circut, intermittent operation, deterioration of performance outside specified limits, mechanical faults, etc.

Note 9 — If available, drawings, photographs and test data sheets should be attached to the report. If required, failed items should be returned to the responsible authority. In case of removal of an item from observation, it shall be reported to the responsible authorities.

Note 10 — In offering observations, consideration should be given to the prime cause of failure and secondary failures or cause and secondary effects of a failure, such as the weakening of a spring or the deterioration of a contact and its effect on wear-out or life of any associated item.

Note 11 — Persons to whom a copy of the report is to go should be mentioned in the report.

INTERNATIONAL SYSTEM OF UNITS (SI UNITS)

Base Units

QUANTITY	UNIT	SYMBOL
Length	metre	m
Mass	kilogram	kg
Time	second	s
Electric current	ampere	A
Thermodynamic temperature	kelvin	K
Luminous intensity	candela	cd
Amount of substance	mole	mol

Supplementary Units

QUANTITY	UNIT	SYMBOL
Plane angle	radian	rad
Solid angle	steradian	sr

Derived Units

QUANTITY	UNIT	SYMBOL	DEFINITION
Force	newton	N	1 N = 1 kg m/s^2
Energy	joule	J	1 J = 1 N.m
Power	watt	W	1 W = 1 J/s
Flux	weber	Wb	1 Wb = 1 V.s
Flux density	tesla	T	1 T = 1 Wb/m^2
Frequency	hertz	Hz	1 Hz = 1 c/s (s^{-1})
Electric conductance	siemens	S	1 S = 1 A/V
Electromotive force	volt	V	1 V = 1 W/A
Pressure, stress	pascal	Pa	1 Pa = 1 N/m^2

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